

ON A COLLECTION OF CRINOIDS FROM THE INDIAN OCEAN AND THE BAY OF BENGAL.

By AUSTIN H. CLARK, U. S. National Museum, Washington, D.C.

The Zoological Survey of India, through Dr. Bains Prashad, has recently done me the honour of submitting to me for study an unusually interesting collection of crinoids from the Indian Ocean and the Bay of Bengal.

In this collection the following twenty-two species are represented:—

<i>Cupillaster multiradiata</i> (Linné).	<i>Heterometra reynaudi</i> (J. Müller).
<i>Comatella maculata</i> (P. H. Carpenter).	<i>Heterometra singularis</i> A. H. Clark.
<i>Comissia chadwicki</i> A. H. Clark.	<i>Stephanometra protecta</i> (Lütken).
<i>Comatula micraster</i> A. H. Clark.	<i>Lamprometra palmata</i> (J. Müller).
<i>Comatula pectinata</i> (Linné).	<i>Lamprometra klunzingeri</i> (Hartlaub).
<i>Comaster brevicirra</i> (Bell).	<i>Dichrometra ciliata</i> A. H. Clark.
<i>Comanthus timorensis</i> (J. Müller).	<i>Cyllometra prashadi</i> , sp. nov.
<i>Comanthus parvicirra</i> (J. Müller).	<i>Oligometra serripinna</i> (P. H. Carpenter).
<i>Eudiocrinus ornatus</i> A. H. Clark.	<i>Tropiometra indica</i> A. H. Clark.
<i>Eudiocrinus philenor</i> , sp. nov.	<i>Tropiometra encrinus</i> A. H. Clark.
<i>Craspedometra acuticirra</i> (P. H. Carpenter).	<i>Cosmiometra leilae</i> , sp. nov.

The early references to these species are given in "The Crinoids of the Indian Ocean" (Echinodermata of the Indian Museum, Part VII), Calcutta, November 22, 1912.

After the publication of this work the author was able to study a large amount of additional material, chiefly from the East Indies, and a revised synonymy of the species, together with keys to all the genera and species, was published in "The Unstalked Crinoids of the Siboga Expedition" (Siboga-Expeditie, Monographie XLIIb, Livr. LXXXIII), Leiden, March 1918.

The reason for the use herein of the name *Lamprometra palmata* in place of *L. protectus* given in the memoirs cited, and of *Stephanometra protectus* in place of *S. monacantha*, is explained in a recent paper on some crinoids from the Indian Ocean and the East Indies (*Journ. Linn. Soc. London [Zool.]*, vol. XXXVI, No. 249, May 3, 1929, p. 641).

A complete account of the Superfamily Comasterida, with keys to all the subfamilies, families and higher groups of comatulids, as well as to the genera and species of Comasteridae, has recently been published in "A Monograph of the Existing Crinoids", vol. I, The Comatulids, Part 3, Superfamily Comasterida (Bulletin 82, U. S. National Museum, vol. 1, Part 3), Washington, March 21, 1931.

For the privilege of examining this especially interesting collection I wish to express to Dr. Prashad my deep appreciation.

Superfamily COMASTERIDA.

Family COMASTERIDAE.

Subfamily CAPILLASTERINAE.

Capillaster multiradiata (Linné).

Localities.—"Investigator" station 549; Mergui Archipelago, northwest of King Island (lat. $12^{\circ} 48' 00''$ N., long. $98^{\circ} 16' 10''$ E.); 24 fathoms; mud, sand and shells; October 21, 1913. Three specimens.

Arabian Sea; S. P. Agharkar, March, 1910. One specimen.

Notes.—Of the three specimens from "Investigator" station 549 one has 28 arms, one is smaller, and the third is fragmentary.

The specimen from the Arabian Sea is small.

Comatella maculata (P. H. Carpenter).

Localities.—"Investigator" station 642; Addu atoll, Maldives; S. E. entrance channel; 22 fathoms; coral and sand; March 13, 1923. One specimen.

"Investigator" station 710; Trinkat, Nicobar Islands; February 11, 1926. One specimen.

Notes.—The specimen from "Investigator" station 642 has 20 arms 75—80 mm. long; the cirri have 17—19 (usually 18) segments and are 14 mm. long.

The specimen from "Investigator" station 710 has 22 arms which are about 80 mm. long. The cirri are XII, 17—19, 14 mm. long.

Comissia chadwicki A. H. Clark.

Locality.—"Investigator" station 152; $11\frac{1}{2}$ miles S. 83° W. of Colombo Light, Ceylon; $26\frac{1}{2}$ fathoms; sand, shells and coral; December 12, 1893. One specimen.

Subfamily COMACTINIINAE.

Comatula micraster A. H. Clark.

Locality.—"Investigator" station 570; Trotter Island, east side; November 30, 1913. One specimen.

Notes.—The single specimen is small. The centrodorsal is greatly reduced, though slightly raised above the dorsal surface of the radial ring. There are three cirri remaining which are composed of 8—10 segments of which the longest are nearly or quite three times as long as broad and the outermost are more than twice as long as broad.

Comatula pectinata (Linné).

(Plate XIX, fig. 8.)

Localities.—"Investigator" station 553; Mergui Archipelago, off Tenasserim (lat. $12^{\circ} 49' 15''$ N., long $98^{\circ} 16' 45''$ E.); 27 fathoms; mud, sand and shells; October 23, 1913. Two specimens.

"Investigator" station 549; Mergui Archipelago, northwest of King Island (lat. $12^{\circ} 48' 00''$ N., long. $98^{\circ} 16' 10''$ E.); 24 fathoms; mud, sand and shells; October 21, 1913. Four specimens.

"Investigator" station 624; coral reef off Reed Point, Nancowry Island, Nicobar Islands. One specimen.

Notes.—The two specimens from "Investigator" station 553 are more or less intermediate between *Comatula pectinata* and *C. micraster*. One of them is as large as the average fully grown *C. pectinata*, and the other is slightly smaller. In both the centrodorsal is thin, discoidal with a concave dorsal surface. The centrodorsal of one bears XI small and defective cirri, six of them in three pairs in three of the interradian angles, and the other five in two pairs in the other two interradian angles with another between the pairs. The centrodorsal of the other specimen bears III moderate sized though not fully developed cirri, three very immature cirri of various sizes, and four minute buds in obsolete cirrus sockets.

The four specimens from "Investigator" station 549 are rather large with moderately stout arms.

The specimen from "Investigator" station 624 is very small.

Subfamily COMASTERINAE.

Comatula brevicirra (Bell).

Localities.—"Investigator" station 549; Mergui Archipelago, northwest of King Island (lat. $12^{\circ} 48' 00''$ N., long. $98^{\circ} 16' 10''$ E.); 24 fathoms; October 21, 1913. Four specimens.

"Investigator" station 623; coral reef north-east of Octaria Bay; November 19, 1922. One specimen.

"Investigator" station 624; coral reef off Reed Point, Nancowry Island, Nicobar Islands; February 13, 1922. Three specimens.

Notes.—The specimen from "Investigator" station 549 has 21 arms.

In the specimen from "Investigator" station 623 the cirri have 11-12 segments.

Of the three specimens from "Investigator" station 624 one has 20 arms which are elongated, becoming greatly attenuated distally; the cirri have 10—13 (usually 11) segments. Another specimen is evidently of the same species, although there are eight IIIBr series present making a total of 29 arms. The arms are slender and are much attenuated distally, reaching a length of about 100 mm. The several post-radial series have 5, 5, 5, 7, 7=29 arms. The cirri have 12 segments. The third specimen has 29 arms about 100 mm. long. There are 11—13 cirrus segments.

Comanthus timorensis (J. Müller).

Locality.—"Investigator" station 549; Mergui Archipelago, northwest of King Island (lat. $12^{\circ} 48' 00''$ N., long. $98^{\circ} 16' 10''$ E.); 24 fathoms; mud, sand and shells; October 21, 1913. One specimen.

Notes.—The single specimen has 35 arms. Of the ten IIBr series present six are 4(3+4) and four are 2. The following division series are all 4(3+4). The centrodorsal is pentagonal and is sunken almost to the level of the radial circlet; it bears two small cirrus stumps.

***Comanthus parvicirra* (J. Müller).**

Localities.—"Investigator" station 527; Mergui Archipelago, south and west coast of Macleod Island; March 23—24, 1913. One specimen.

"Investigator" station 623; coral reef north-east of Octavia Bay, Nancowry Harbour; November 19, 1922. Two specimens.

"Investigator" station 629; coral and mud flat on the northwestern side of Spiteful Bay near Leader Point; November 7, 1922. One specimen.

Port Blair, Andaman Islands; G. H. Booley, April 12, 1889. One specimen.

Notes.—The specimen from "Investigator" station 527 has 20 arms. All ten of the IIBr series are 4(3+4). The cirri are IX, 13, arranged in a single interrupted marginal row on the centrodorsal.

The specimen from Port Blair has 29 arms about 75 mm. long. The cirri are VII, with in addition a few small stumps, the longest 7 mm. long and composed of 12—13 segments.

Superfamily MARIAMETRIDA.

Family EUDIOCRINIDAE.

***Eudiocrinus ornatus* A. H. Clark.**

Locality.—"Investigator" station 387; off Cape Negrais, Burma (lat. 15° 25' N., long. 93° 45' E.); 40—49 fathoms; sand and coral; November 16, 1909. One specimen.

Notes.— P_a reaches 12 mm. in length and is composed of 18 segments of which the distal are from three to four times as long as broad.

***Eudiocrinus philenor*, sp. nov.**

(Plate XIX, figs. 1—4.)

Locality.—"Investigator" station 534; Mergui Archipelago, west of Tavoy Island (lat. 12° 59' N., long. 96° 48' 30" E.); 60 fathoms; coral and sand; April 17, 1913. Fourteen specimens.

Description.—The centrodorsal is discoidal, thin, with a rather broad, flat, and more or less rugose polar area. In small specimens the dorsal pole is more or less strongly convex. The cirrus sockets are arranged in a crowded zigzag row, alternating higher and lower; rarely there are two sockets one above the other.

The cirri are XX—XXV, 13—15 (usually 14), 10 mm. long, slender and delicate and only moderately curved. The first segment is very short, the second is longer, about twice as broad as long or somewhat

shorter, the third is half again as long as the median width, the fourth is about three and one-half times as long as the median width, and the three following are about four times as long as the median width; the segments succeeding slowly decrease in length so that the antepenultimate is about twice as long as broad and the penultimate is about as long as broad or slightly longer than broad. The third segment is rather strongly constricted centrally. The next few segments are moderately constricted centrally, and those succeeding have a slightly concave ventral profile, but soon a less strongly concave dorsal profile. The antepenultimate segment is practically oblong in lateral view. The opposing spine is prominent and sharp, terminally situated, and is equal in height to about half the distal width of the penultimate segment. The terminal claw is about as long as the penultimate segment or slightly longer, and is slender and moderately and evenly curved.

The gently concave distal edge of the radials extends slightly beyond the rim of the centrodorsal. The syzygial pair formed by the two elements of the IBr series is oblong and half again as broad as long. The IBr₁ has a low and broadly rounded elevation occupying the median line. The IBr₂ has a corresponding but somewhat less strongly marked midradial elevation, and the distal edge is slightly everted.

The 5 arms are about 40 mm. long. The first brachial is short, oblong, about four times as broad as long, of about the same size as the IBr₁ and with a similar midradial elevation. The distal border is slightly everted. The second brachial is slightly larger than the first, and is trapezoidal in shape; it bears a slight median elevation in the proximal half or two-thirds, and the distal edge is slightly everted. The syzygial pair formed by brachials 3+4 is slightly longer on the side bearing the pinnule than on the opposite side, and is not quite twice as broad as long. The hypozygal is oblong, nearly four times as broad as long, and the epizygal is longer on the side toward the pinnule base than on the opposite side, in the midradial line being of the same length as the hypozygal. The next two brachials are very bluntly wedge-shaped, about two and one-half times as broad as the midradial length. After the second syzygy the brachials become triangular, as long as or somewhat longer than broad, but soon wedge-shaped again with less oblique ends, later becoming longer with slightly concave sides. The brachials as far as the second syzygy have a low and broadly rounded tubercle in the proximal portion. The succeeding brachials have the middle of the dorsal line almost imperceptibly elevated.

Syzygies occur between the elements of the IBr series, between brachials 3+4, 8+9 and 13+14, and distally at intervals of 3 muscular articulations.

P₅ is 4 mm. long with 11 segments of which the first is short and trapezoidal, half again as broad as the greater (inner) length, the second is almost oblong, twice as broad as the median length, the third is about as long as broad, the fourth is half again as long as the median length, and those following slowly increase in length, becoming nearly three times as long as broad terminally. The third and following segments have the distal edge very slightly everted. The pinnule is moderately stout at the base and tapers evenly to the tip. The mid-dorsal line is

very obscurely and roundedly elevated, scarcely suggesting the carination found in related species.

P_1 is 4 mm. long with 12 segments and resembles P_D .

P_a is 8 mm. long with 15 segments, roughly half again as broad at the base as P_D , moderately slender and tapering evenly to a fine tip. It is somewhat flattened laterally and is broadly rounded dorsally, not being prismatic. The first segment is from half again to twice as broad as long, the second is slightly broader than long, the third is slightly longer than broad, the fifth is twice as long as the median width, and the eighth or ninth and following are about three times as long as broad. The longer segments are very slightly constricted centrally, and the distal ends are slightly prominent and are armed with exceedingly fine spines.

Comparisons.—This new species is more or less intermediate between *E. junceus* in which the cirri are greatly elongated, slender, composed of usually 22 greatly elongated segments, and taper gradually from the base to the tip, and the other species of the genus in which the cirri are much shorter and are composed of fewer segments of which the longest are never more than twice as long as broad and the distal are about as long as broad. It seems to be most closely related to *E. ornatus* from which it differs in having the cirri more slender with more elongated segments, in the longer P_a and P_2 , in having the ossicles of the IBr series and the earlier brachials distinctly, though roundedly, carinate, and in having the distal edge of the earlier brachials much less produced.

Family HIMEROMETRIDAE.

***Craspedometra acuticirra* (P. H. Carpenter).**

Locality.—East side of Trotter Island, Mergui Archipelago; November 30, 1913. One broken specimen.

***Heterometra reynaudi* (J. Müller).**

Localities.—Tuticorin Harbour; shore collecting; Dr. H. S. Rao, February-March, 1926. One specimen.

“Investigator”; entrance to Palk Strait, between Ceylon and India; Point Pedro bearing south-south-east, distant about 3 miles; 6—8 fathoms; sandy bottom; 1893—1894. One specimen.

Bengal Fisheries steamer “Golden Crown”; off Gopalpore; 30—38 fathoms; December 1909. One specimen.

Bengal Fisheries steamer “Golden Crown”; Puri Beach, Orissa. One specimen.

Notes.—The specimen from Tuticorin Harbour has 17 arms, and that from Puri Beach has 16 arms.

***Heterometra singularis* A. H. Clark.**

Localities.—“Investigator” station 549; Mergui Archipelago, north-west of King Island (lat. $12^{\circ} 48' 00''$ N., long. $98^{\circ} 16' 10''$ E.); 24 fathoms; mud, sand and shells; October 21, 1913. Two specimens.

"Investigator" station 548; Mergui Archipelago, north-west of King Island (lat. $12^{\circ} 49' 23''$ N., long. $98^{\circ} 23' 30''$ E.); 23 fathoms; mud, sand and shells; October 21, 1913. One specimen.

Notes.—The specimens from "Investigator" station 549 have 15 and 27 arms.

The specimen from "Investigator" station 548 has 20 arms. Of the nine IIBr series present six are 4(3+4) and three are 2. One IIIBr 2 series is present, developed internally on a IIBr 2 series. The cirri are XV, with several additional rudimentary, 41—44, up to 35 mm. in length.

Family MARIAMETRIDAE.

***Stephanometra protecta* (Lütken).**

Locality.—Addu atoll, at the southern end of the Maldivé Archipelago; lagoon reef. One specimen.

Notes.—There are 25 arms which are about 105 mm. long. The cirri are 21 mm. long and are composed of 19—22 segments. P_2 is very long, but rather slender.

***Lamprometra palmata* (J. Müller).**

(Plate XIX, fig. 9.)

Localities.—"Investigator" station 638; on reef flats on the outer side of Malikudu and Kaluhera Islands, Addu atoll, Maldives; February 25, 1923. One specimen.

"Investigator" station 509; Port Maria, Elphinstone Island, Mergui Archipelago; February 2, 1913. One specimen.

Madras; station 5; Harbour; 5 fathoms; Dr. S. W. Kemp, May 3, 1918. One specimen.

Tuticorin Harbour; shore collecting; Dr. H. S. Rao, February-March, 1926. Twenty-seven specimens.

"Investigator" station 391; off the Travancore coast (lat. $9^{\circ} 14' 10''$ N., long. $75^{\circ} 45'$ E.); 237 fathoms; April 27, 1911. One specimen.

Neendakara Bar, Travancore State; Drs. H. S. Rao and M. Sharif, February, 1928. Twenty-seven specimens.

Arabian Sea; Dr. S. P. Agharkar, October 8, 1912. One specimen.

Notes.—The specimen from Madras, station 5, has 37 arms. A small parasitic gastropod of the genus *Melanella* is attached to the base of one of the cirri.

The specimens from Neendakara Bar are slenderly built, and P_2 , though greatly elongated and much stouter than P_1 or P_3 , is rather slender.

The specimen from the Arabian Sea has 42 arms which are about 65 mm. long. P_2 , though much stouter than P_1 and P_3 and greatly elongated, is unusually slender.

Lamprometra klunzingeri (Hartlaub).

Locality.—Abu Zanima, Gulf of Suez; Captain R. B. S. Sewell, I.M.S., July 1916. One specimen.

Dichrometra ciliata A. H. Clark.

Locality.—"Investigator" station 549; Mergui Archipelago, north-west of King Island (lat. $12^{\circ} 48' 00''$ N., long. $98^{\circ} 16' 10''$ E.); 24 fathoms; mud, sand and shells; October 21, 1913. One specimen.

Notes.—The 40 arms are 90 mm. long. The colour is white; the first syzygial pair is deep purplish brown, forming a conspicuous narrow ring about the central portion of the animal; the following syzygial pairs and the immediately adjacent proximal and distal brachials are also deep brownish purple.

Family COLOBOMETRIDÆ.

Cyllometra prashadi, sp. nov.

(Plate XIX, figs. 5—7.)

Locality.—"Investigator" station 535; Mergui Archipelago, west of Tavoy Island (lat. $13^{\circ} 04' 30''$ N., long. $96^{\circ} 44'$ E.); 65 fathoms; sand and mud; April 17, 1913. Four specimens.

Description.—The centrodorsal is broad, thin discoidal, with the dorsal pole 3.5 mm. in diameter, slightly raised in the centre, depressed in the peripheral third, and rising again at the bases of the cirri. The cirri are arranged in a single fairly regular marginal row.

The cirri are XV, 41—46 (usually nearer the latter), about 20 mm. long. The first segment is about twice as broad as long or somewhat longer and those following gradually increase in length to about the eighth or tenth which, with those succeeding, is from one-third to one-half again as broad as long. The cirri taper slightly in the distal third. On the third and following segments the dorsal surface rises considerably from the proximal to the distal end, which is more or less raised in the middle and is armed with fine spines. After the fifth or sixth the segments show dorsally two terminally situated dorsal spines, one on either side. Distally these spines gradually become more slender and longer, and slowly move proximally, on the fourth segment before the penultimate coalescing into a transversely elongate tubercle which on the antepenultimate becomes a simple median tubercle. The opposing spine is low, median, with the apex transversely elongated forming a short transverse ridge with the crest strongly convex. The terminal claw is somewhat longer than the penultimate segment and is rather stout and rather strongly curved.

The distal border of the radials is even with the rim of the centro-dorsal in the mid-radial line, but a considerable portion of the antero-lateral part of the radials is visible in the inter-radial angles. The antero-lateral angles of adjacent radials are separated by deep and rather broad notches. The IBr_1 are very short and band-like, about eight times as broad as the median length, half again as long laterally as in the median line. The lateral borders are rather strongly convergent, and they are widely separated from their neighbours. A low and broadly rounded median elevation occupies the mid-dorsal line. The IBr_2 (axillaries) are very broadly pentagonal, about twice as broad as long. Their lateral borders are about as long as those of the IBr_1 , with which they make an angle of about 120° . There is a prominent more or less laterally compressed synarthrial tubercle on the articulation between the elements of the IBr series. It is continued proximally into the mid-dorsal elevation on the IBr_1 and distally in the form of a similar elevation occupying the proximal half of the axillary. The $IIBr$ series are 2 and resemble the IBr series. The two ossicles immediately following each axillary are united interiorly in their proximal two-thirds, their inner borders then diverging at an angle of 90° .

The 16 arms are about 70 mm. long. The first eight or ten brachials have a distinct, though low and rounded, gable-like median keel, and the brachials following have the distal edge very slightly produced and armed with excessively fine spines.

P_1 is 6 mm. long with 16 segments of which the first is very short, the second is about as long as broad, and those following slowly increase in length, becoming about three times as long as broad terminally. The pinnule is slender and delicate, and tapers gradually from the base to a very slender tip.

P_a is absent.

P_2 is much stouter and stiffer than P_1 , 12 mm. long with 18 segments of which the first is twice as broad as long, the second is about as long as broad, and those following gradually increase in length to the eighth, which is twice as long as broad, and the terminal, which are somewhat longer. The segments in the outer half of the pinnule have the distal ends armed with a conspicuous everted border of fine spines which are longest on the side toward the arm tip.

P_3 is 11.5 mm. long with 17 segments and resembles P_2 .

P_4 is 7.5 mm. long with 15 segments and resembles the two preceding pinnules, but is more slender, especially in the distal half.

The colour in alcohol is purplish brown vaguely blotched with lighter; the cirri are whitish.

Notes.—Three additional specimens have 16+, 14+ and 11+ arms.

Comparisons.—This new species is at once distinguished from all the others in the genus by the long cirri which are composed of very numerous segments. In the character of its cirri it comes nearest *C. soluta*, but the cirri are longer with more numerous segments and longer dorsal spines, P_3 resembles P_2 instead of being much shorter and more slender, and the distal ends of the pinnule segments are much more spiny.

Oligometra serripinna (P. H. Carpenter).

Locality.—Madras; station 11; entrance to the Harbour; 4--5 fathoms; Dr. S. W. Kemp, May 8, 1918. One specimen.

Notes.—The arms are 80 mm. long. The cirri are XV, 22--24, 10 mm. long. P₂ is 7 mm. long with 15 segments, very stout, with prominent processes at the prismatic angles of the segments.

Superfamily TROPIOMETRIDA.

Family TROPIOMETRIDAE.

Tropiometra indica A. H. Clark.

Locality.—Neendakara Bar, Travancore State; Drs. H. S. Rao and M. Sharif; February, 1928. One specimen.

Notes.—The arms are about 100 mm. long. The carination of the brachials is slight, but when the specimen is dry it is easily made out in the proximal half of the arms. In the distal half of the arms it gradually becomes more and more obscure, and in the terminal fourth of the arms there may be no trace of carination, the brachials having an evenly rounded dorsal surface and slightly produced and finely spinose distal ends.

The centrodorsal is thick discoidal with the broad flat dorsal pole about 5 mm. in diameter.

The cirri are XXXVIII, 22--25, about 20 mm. long. The cirrus segments are subequal, usually about twice as broad as long, those in the outer third of the cirri being usually very slightly broader than those in the proximal half.

Tropiometra encrinus A. H. Clark.

(Plate XIX, figs. 10--12; Plate XX, figs. 13--17.)

Antedon carinata (part) P. H. Carpenter, *Notes from the Leyden Mus.*, III, 1881, p. 179 (Indian Ocean).—P. H. Carpenter, *Journ. Linn. Soc. London (Zool.)*, XVI, 1882, p. 502 (Java).—P. H. Carpenter, "*Challenger*" *Reports, Zoology*, XI, part 32, 1884, p. 137 (Java); XXVI, part 60, 1888, pp. 200, 202 (Java).—Hartlaub, *Mem. Mus. Comp. Zool.*, XXVII, No. 4, 1912, p. 371 (?Fiji; ?Kingsmill [or Gilbert] Islands; ?Java).

Antedon marmorata (Vienna Mus., MS.) P. H. Carpenter, "*Challenger*" *Reports, Zoology*, XXVI, part 60, 1888, p. 202 (Norfolk Island; *nomen nudum*).

Tropiometra carinata (part) A. H. Clark, *Smithsonian Miscell. Coll.* (Quarterly Issue), L, part 3, 1907, p. 349 (included under this name up to 1911).—A. H. Clark, *Vidensk. Medd. fra den naturhist. Forening Kobenhavn*, 1909, p. 182 (East Indies).

Tropiometra, sp. A. H. Clark, *American Naturalist*, XLII, No. 500, 1908, p. 541.—A. H. Clark, *Notes from the Leyden Mus.*, XXXIII, 1911, p. 189 (Indian Ocean; "South Pacific").—A. H. Clark, *Beiträge zur Kenntnis d. Meeresfauna Westafrikas, Echinod. II, Crinoidea*, 1914, p. 313 (?Fiji; ?Kingsmill Islands).

Antedon encrinus (Lütken, MS.) A. H. Clark, *Vidensk. Medd. fra den naturhist. Forening Kobenhavn*, 1909, p. 117 (synonym of *T. carinata*).

Tropiometra encrinus A. H. Clark, *Proc. U. S. Nat. Mus.*, XL, 1911, p. 36 (in part; east coast of Asia).—A. H. Clark, *Notes from the Leyden Mus.*, XXXIII, 1911, p. 189 (comparison with *Tropiometra*, sp. [=indica] from the Indian Ocean).—A. H. Clark, *Die Fauna Südwest-Australiens*, III, Lief. 13, 1911, p. 440 (East Indian species).—A. H. Clark, *Memoirs Australian Mus.*, IV, 1911, p. 722 (range in Australia unknown); p. 735 (in key; Queensland [error]); p. 780 (no definite Australian records; "South Pacific," possibly Australia; Norfolk Island; Marshall Islands).—A. H. Clark, *Records Indian Museum*, VII, 1912, No. 26, p. 270 (Sadras [=Madras]).—A. H. Clark, *Smithsonian Miscell. Coll.*, LX, No. 10, 1912, p. 29 (Java; specimen not seen).—A. H. Clark, *Proc. U. S. Nat. Mus.*, XLIII, 1912, p. 384 (identity); p. 402 (comparisons with related species; eastern Asia; Indian Ocean; ?India; descriptions).—A. H. Clark, *Crinoids of the Indian Ocean*, 1912, p. 177 (in part; east coast of Asia; Java); fig. 29, p. 178.—A. H. Clark, *Proc. Biol. Soc. Washington*, XXVI, 1913, p. 179 (range in eastern Asia).—A. H. Clark, *Beiträge zur Kenntnis d. Meeresfauna Westafrikas, Echinod.* II, *Crinoidea*, 1914, p. 313 (range; ?India; East Indies; Eastern Asia).—A. H. Clark, *Journ. Washington Acad. Sci.*, V, No. 6, 1915, p. 214.—H. L. Clark, *Spolia Zeylanica*, X, part 37, 1915, p. 85 (Ceylon; two characteristic specimens); p. 93 (occurs in Ceylon).—A. H. Clark, *Unstaked Crinoids of the Siboga Exped.*, 1918, p. 131 (in key; range).—Gislén, *Nova Acta reg. Soc. sci. Upsaliensis*, (ser. 4) V, No. 6, 1922, p. 92 (Bock's Sta. 45; notes); figs. 70, 71, p. 88.—Gislén, *Zool. Bidrag Uppsala*, IX, 1924, p. 41.

Localities.—Pamban Beach, Ramnad District, Madras Presidency in dead corals; Drs. B. Chopra and H. S. Rao; February, 1925 (No. 4). One specimen.

Near Mandapam (or Mandapan), Madras Presidency (lat. 9° 17' N., long. 79° 12' E.); 2—4 fathoms; September 15, 1925. Five specimens.

Madras; station 5; Harbour; 5 fathoms; Dr. S. W. Kemp; May 3, 1918 (Nos. 14, 33, 34, 42). Four specimens.

Waltair, about three miles north of Vizagapatam; station 1; rocks and beach south of Lawson's Bay; Dr. S. P. Agharkar; January 22, 1921. One specimen.

Notes.—In the specimen from Pamban Beach the cirri are XXV, 26; the segments are subequal, usually about half again as broad as long, but in some cirri nearly or quite twice as broad as long.

The specimens from near Mandapam may be thus described:—

The centrodorsal is a thin to rather thick disk with the broad dorsal pole 5—6 mm. in diameter, flat or slightly concave, more or less marked with faint radiating lines, and toward the periphery raised at the bases of the larger cirri. The cirri are arranged in one and a partial second, two, or two and a partial third, marginal rows.

The cirri are XXV, 29—34 (usually 32—33), from 30 to 35 mm. long. The first segment is very short, commonly a thin disk from six to eight times as broad as long, and the second is between two and two and one-half times as broad as long. The following segments may remain subequal, between half again and twice as broad as long, or they may become somewhat longer on the fifth-ninth or sixth-tenth, and shorter again in the distal half of the cirri. The distal edge of the cirrus segments in lateral view is very strongly sinuous. The cirri may remain uniform in width, as viewed laterally, until the last six or eight segments on which they taper to the tip, or they may taper very gradually in the distal half, third or fourth; sometimes they broaden almost imperceptibly from about the eighth segment, slowly tapering in the distal fourth. The antepenultimate segment is small, wedge-shaped, slightly broader than the ventral length. The terminal claw is about

half again as long as the antepenultimate segment, and is rather stout and moderately and evenly curved.

The radials are just visible beyond the rim of the centrodorsal, or they are concealed in the midradial line, their anterolateral angles being visible in the inter-radial angles of the calyx where the anterolateral angles of the adjacent radials form together a low triangle of which the very sharp lateral angles almost or quite meet in the midradial line. The IBr_1 are exceedingly short, from six to eight times as broad as long, and may be partially concealed by the centrodorsal. They are in lateral contract. Their proximal and distal borders are slightly prominent. The IBr_2 (axillaries) are triangular, twice as broad as long, with the distal sides slightly or moderately concave. The proximal half of the midradial line of the axillaries and the adjacent portion of the IBr_1 is raised into a small, low, and very broadly rounded, often obscure, synarthrial tubercle.

The 10 arms are about 180 mm. long. The first two brachials are markedly larger than those succeeding, this being especially true of the second. The first brachials are wedge-shaped, half again as long exteriorly as interiorly, and more or less completely united interiorly. The second brachials are triangular, with the outer edge more or less longer than the outer edge of the first brachials, and the inner edge reduced to a point. The first syzygial pair (composed of brachials 3+4) is wedge-shaped, slightly more than twice as broad as the median length; the hypozygal (third brachial) is very short and band-like, with the proximal and distal borders parallel. The inner edge of the epizygal (fourth brachial) is as long as, or slightly longer than, the inner edge of the hypozygal, but the outer edge is reduced to a point. The next four brachials are oblong, about four times as broad as long. After the second syzygy the brachials are triangular, short, about four times as broad as the median length, with a small rounded triangular projection in the mid-dorsal line and a prominent angle deeply incising the proximal border of the succeeding brachial half way between the mid-dorsal line and the base of the pinnule. After about the thirtieth the brachials become wedge-shaped again, and after the proximal third of the arm slowly increase in length so that the terminal brachials are longer than broad with slightly oblique ends. The distal ends of the brachials are marked with exceedingly fine longitudinal striations, and the distal edges are very finely spinous. On the distal brachials most of the dorsal surface is marked with fine striations. The first two brachials have a broad but very low and somewhat obscure median carination. On the brachials succeeding this is narrowed, becoming a fine low narrow line with the distal portion somewhat elevated, so that the dorsal profile of the arm is strongly serrate. This carination becomes obscure after the proximal fourth of the arm, and in the outer half of the arm completely disappears, the dorsal profile of the arm becoming entirely smooth.

Syzygies occur between brachials, 3+4, 9+10 and 14+15, and distally at intervals of from 4 to 9 (usually 6) muscular articulations.

P_1 is 15 mm. long, moderately stout in the proximal half but slender in the distal half, and is composed of 25 segments of which the first is

half again as broad as long, the second is twice as broad as long, the third is half again as broad as long, and those following gradually increase in length, becoming about as long as broad in the middle of the pinnule and twice as long as broad terminally. The pinnule is strongly prismatic, and when viewed from the side toward the arm tip shows a well-marked, though low, longitudinal crest.

P_2 is of about the same length as P_1 and is composed of 25 segments. It resembles P_1 but tapers more gradually so that it appears somewhat stouter in the distal half.

P_3 is 15 mm. long with 26 segments, slightly stouter than P_2 with a somewhat more prominent dorsal crest and with the distal ends of the segments on the side toward the arm base slightly produced. It bears a long fusiform gonad extending to the sixteenth segment.

The next three or four pinnules are similar, and those following very slowly decrease in length, the twentieth being 9 mm. long with 23 segments.

The distal pinnules are exceedingly slender and hair-like, about 20 mm. long with 57 segments.

The disk is 25 mm. in diameter and is not incised. The five ambulacral grooves running from the mouth usually fork about half way between the mouth and the periphery of the disk, though sometimes nearer the latter. In two specimens the individual arms of the anterior and right anterior pairs are supplied with grooves arising directly from the peristome, so that seven groove trunks radiate from the mouth, three forking and four remaining undivided.

The colour in alcohol is purplish brown, with the arms in the outer half or two-thirds narrowly and abundantly banded with dull orange yellow.

In one of the specimens from Madras (No. 14) the cirri are XXV, 26, from 25 to 27 mm. long. All the cirrus segments are subequal, all being about twice as broad as long.

The lower brachials have a narrow but well-developed median carination which rises rapidly from the proximal to the distal end so that in lateral view the dorsal profile of the arms is very strongly serrate. After the proximal quarter of the arms this gradually dies away, becoming obsolete and almost completely disappearing in the outermost portions of the arms, though very faint suggestions of it remain.

The colour is light purplish brown finely mottled with dull yellowish, most abundantly on the division series and proximal fourth of the arms; the cirri are dull yellowish, becoming more or less brownish ventrally.

In another specimen from Madras (No. 33) the cirri are XXV, 23—24, from 20 to 22 mm. in length. The segments are subequal, half again as broad as long, or twice as broad as long, or the earlier segments are from half again to twice as broad as long and the distal portion of the cirri is slightly broadened in lateral view with the segments shorter, up to two and one-half times as broad as long.

The arms are 150 mm. long.

The colour is light dull yellowish, the arms mottled with purplish brown for the first 20—25 mm. then narrowly banded, the bands involving two or three brachials and being separated by four or five.

In a third specimen from Madras (No. 34) the cirri are XXIII, 26—27, 20 mm. long. The segments are subequal, about twice as broad as long. The arms are 150 mm. long.

In the fourth specimen from Madras (No. 42) the cirri are XXV, 19—24, from 15 to 18 mm. long. The segments are subequal, half again as broad as long, or twice as broad as long, or somewhat shorter distally than proximally. The colour is dull yellowish, the arms narrowly and frequently banded with purplish, becoming mottled on the arm bases.

In the specimen from Waltair the cirri are XXX, 16—19. The segments are subequal, half again as broad as long, slightly longer or slightly shorter. The arms are probably about 75 mm. long.

Remarks.—The status of the smaller species of *Tropiometra* occurring in the Indo-Pacific region is still unsettled. There seem to be four forms which, at least when typically developed, are quite distinct. These four forms, with their ranges, are the following:

Tropiometra carinata (Lamarck): Seychelles; Farquhar Atoll; Cargados Carajos; Mauritius; Madagascar; southeastern and southern Africa from Zanzibar to Simons Bay (Zanzibar; Mozambique; Delagoa Bay [Lorenço Marquez]; off the Tugela River mouth; off Durnfora Point, Zululand; off the Itongazi River, Natal; off Algoa Bay; False Bay; Simons Bay).

Tropiometra audouini A. H. Clark: Red Sea and eastward to Muscat (Suez; Tor; Erg Tor; Ras-el-Millan; Aden; Muscat).

Tropiometra indica A. H. Clark: Ceylon (Gulf of Manaar and western coasts); Tuticorin, Madras Presidency; and Neendakara Bar, Travancore State.

Tropiometra encrinus A. H. Clark: Eastern coast of India from Waltair south to Pamban Beach (Waltair; Madras; Mandapam; Pamban Beach); Ceylon; Java; Norfolk Island; Fiji; Gilbert (Kingsmill) Islands; Marshall Islands; and the Bonin Islands. Also recorded without precise locality from the Bay of Bengal, Indian Ocean, East Indies, ? India, eastern Asia, South Sea Islands, and South Pacific Ocean.

Of these four species only *T. carinata* and *T. indica* are known from a considerable number of specimens. Except for those described above *T. encrinus* is known from only a very few specimens from widely scattered localities which have not been compared directly, though from what can be learned about them they seem all to be referable to the same form.

As the synonymy of these species is in a much confused state, it has seemed advisable to give a complete list of the references to the present form.

The specimens from Ceylon described under the name of *Tropiometra encrinus* in "*The Crinoids of the Indian Ocean*," p. 177, are in reality *T. indica*.

Family THALASSOMETRIDAE.

Subfamily THALASSOMETRINAE.

***Cosmiometra leilae*, sp. nov.**

(Plate XX, figs. 18—19.)

Locality.—"Investigator" station 465; south of Ceylon (lat. $5^{\circ} 56'$ N., long. $81^{\circ} 22'$ E.); 109—132 fathoms; April 22, 1912. Two specimens.

Description.—The centrodorsal is thick discoidal about 4 mm. in diameter at the base and 1.5 mm. high with the broad rugose dorsal pole about 3 mm. in diameter. The cirrus sockets are arranged in fifteen crowded columns of one or two each, there being three columns in each radial area; but rarely the median column is absent, leaving two lateral columns separated by a bare slightly depressed space as broad as a column, or the middle column may consist of a single more or less undeveloped cirrus. The radial areas on the centrodorsal are not usually differentiated, but in rare cases there is a narrow sharp ridge that runs down from the ends of the basal rays.

The cirri are XXV, 31—40 (apparently usually about 35), up to 33 mm. in length. The first segment is three or four times as broad as long or even shorter, the second is about twice as broad as the greatest (ventral) length, the third is about half again as broad as long, the fourth varies from slightly broader than long to about one-third again as long as broad, and those following increase in length to the eighth, a transition segment, which is three times as long as the median width. The succeeding segments rapidly decrease in length, the eleventh or twelfth being about as long as broad and the seventeenth and following about half again as broad as long, or sometimes slightly longer. The central portion of the distal dorsal edge of the transition (eighth) segment is slightly produced; on the segments following this is raised into an abrupt high process arising from the end of the second third of the dorsal surface of the segment with, when viewed along the axis of the cirrus, a rounded or more or less lobate distal end. Distally this process gradually narrows and at the same time arises from more and more of the dorsal surface of the segments, becoming on the short outer segments a high and conspicuous dorsal spine with a strongly rounded, but not carinate, dorsal crest, and a roundedly blunted tip. The opposing spine is small, smaller than the dorsal spine on the preceding segment, and blunt; it is terminally situated. The terminal claw is longer than the penultimate segment, rather slender, and moderately and evenly curved.

The ends of the basal rays are prominent in the angles of the calyx as rather small tubercles between the apposed anterolateral angles of the radials and the rim of the centrodorsal.

The radials are short, strongly curved, with the dorsal surface depressed within the rim of the centrodorsal, especially laterally, making the ends of the basal rays conspicuous. The $I\text{Br}_1$ are very short, about six times as broad as the median length, and are in lateral contact. The

midradial line bears a rather high median carination. The anterolateral angles may bear single tubercles or short blunt spines. The $I\text{Br}_2$ (axillaries) are very short, about three times as broad as long, and are rhombic with the lateral angles slightly truncated. The entire median line is occupied by a rather high narrow carination, and the edges are slightly everted and produced, most so on the proximal side. Prominent water pores are present beneath the apposed lateral angles of the axillaries. The $II\text{Br}$ series are 2, resembling the $I\text{Br}$ series; but the component elements are proportionately longer and the axillaries have much more broadly truncated lateral angles. Rather conspicuous water pores are present on both sides of the $II\text{Br}$ series. The $III\text{Br}$ series are 2, always externally developed, and resemble the $II\text{Br}$ series. The outer side of the axillary is about three times as long as the inner, the latter being broadly cut away for the formation of the water pore.

The 24—26 arms are probably over 100 mm. long. The first two brachials are prominently carinate, like the elements of the division series. Their borders are practically unmodified, or are very slightly and rather broadly thickened. There is a prominent water pore between the adjacent first two brachials on each arm pair, formed chiefly by the cutting away of the proximal inner angle of the second brachials. A low but prominent median carination, abruptly set off from the dorsal surface of the brachials, runs along the arms to the tip.

P_1 is slender and not greatly stiffened, 10 mm. long with 17 segments. The first segment is about as long as broad, the second is slightly longer than broad, the third is nearly half again as long as broad, and those following slowly and gradually increase in length so that the fourteenth is twice as long as broad and the sixteenth is about three times as long as broad. The distal ends of the segments are very slightly prominent, though not everted or otherwise modified, and the distal angles on the side toward the arm tip are slightly produced, overlapping the base of the segment following.

P_2 is 8 mm. long with 15 segments and resembles P_1 .

P_3 is 7 mm. long with 12 segments and resembles P_2 .

P_4 is 5 mm. long with 12 segments.

The lower pinnules are all about equally stout basally, and all taper slowly and evenly to the tip.

The color in alcohol is dull white with the perisome brown.

Comparisons.—*Cosmiometra leilae* appears to be most closely related to *C. delicata* of the Hawaiian Islands, but it is a much stouter species with a much broader and lower centrodorsal on which the cirri are arranged in fifteen instead of in ten columns, the transition segment in the cirri is the eighth instead of the sixteenth, and the carination of the brachials is higher, narrower, and more conspicuous.